Some aspects of biomagnetic investigations

Z. Drzazga[1], M. Bartoszek[2], B. Beck[3], and A. Cholewka[1]

[1]Department of Medical Physics, University of Silesia
Uniwersytecka 4, 40-007 Katowice, Poland
[2]Department of Chemistry and Environmental Technology, University of Silesia,
Uniwersytecka 4, 40-007 Katowice, Poland
[3]Department of Biophysics, Silesian Medical University, Jordana 19, 41-808 Zabrze, Poland

Biomagnetism is interdisciplinary that combine physics and engineering with biology and medicine. It involves the measurements of intrinsic properties of material as well as stimulation of biological system with magnetic field. An interest in this problem is connected with increase of the magnetic field application in medical diagnosis and therapy. Therefore studies of magnetic effects on different level of biological systems and various life processes require many complementary experimental techniques and accurate interpretation.

One of the main effects is the magnetic orientation of molecules showing anisotropy of diamagnetic or paramagnetic susceptibility. Magnetic anisotropy of heme proteins, iron porphyrins and magnetotactic bacteria has been studied by means of torque method in the wide temperature range. A tendency to aggregate into chains and small groups of hemoglobin particles was observed. The torque curves had a sinusoidal shape due to the uniaxial anisotropy and their amplitude increased almost linearly with magnetic field but did not change with temperature between 77 and 292 K. A marked increase of field-induced magnetic anisotropy was observed only in the very low temperature when long-range magnetic interactions were reveled. Magnetic behavior of studied samples was dependent not only on shape anisotropy but also on the Fe spin state what was confirmed by EPR spectroscopy.

In the case of magnetotactic bacteria (*Desulfovibrio dessulfuricans)* a broadening of EPR lines indicated strong dipole-dipole interaction and some misorientation of magnetic spins of magnetosomes. Moreover resonanse lines derived from free radicals enclosed in the bacteria influenced the EPR spectra. The effective anisotropy coefficient was several times higher for the wild strains than cultivated in laboratory conditions bacteria.

Effect of magnetostatic (DC) and extra low frequency (ELF) magnetic field on the function of hemoglobin and chosen enzymes was examined by various methods. The conformational stability of hemoglobin under DC and ELF magnetic field was studied by differential scanning calorimetry. Hemoglobin exposed to the static magnetic field of 0.9T compared with control showed a slight shift of endothermic peak connected with denaturation process towards higher temperatures that could be interpreted as some increase of hemoglobin stability.

ELF magnetic field influence on alkaline phosphotase activity was studied in *in vitro and in vivo* conditions. An increase of activity of enzyme in serum of Wistar rats (*in vivo*) was obtained while a decrease in *in vitro* experiment. To better insight into interaction of ELF magnetic field with biological objects series of measurements including various parameters of magnetic exposure was done. However explanation of ELF MF phenomena is not clear.

Name of the presenting author (invited): Zofia Drzazga
e-mail address: drzazga@us.edu.pl
url's: http://www.us.edu.pl